R E P O R T R E S U M E S

ED 019 692 CG 001 884

MULTIVARIATE ANALYSIS OF THE VOCATIONAL REHABILITATION PROCESS. FINAL REPORT.

BY- EBER, HERBERT W.
ALABAMA STATE VOCATIONAL REHABILITATION AGENCY
VOCATIONAL REHABILITATION ADMIN. (DHEW)

REPORT NUMBER RD-1518-G PUB DATE JUN 67
EDRS PRICE MF-$0.25 HC-$0.80 18P.

DESCRIPTORS- *MODELS, *VOCATIONAL REHABILITATION, VOCATIONAL COUNSELING, *INFORMATION UTILIZATION, *STATISTICAL ANALYSIS,

THE LOGIC AND METHOD FOR THE DEVELOPMENT OF A MATHEMATICAL MODEL REPRESENTING ASPECTS OF THE VOCATIONAL REHABILITATION PROCESS ARE PRESENTED. THE PROJECT GOALS INCLUDED BUILDING A CONCEPTUAL STRUCTURE WITHIN WHICH VARIOUS FACTORS INFLUENCING REHABILITATION OUTCOME COULD BE MORE CLEARLY UNDERSTOOD, AND PREDICTING SOME OF THE VARIATIONS IN OUTCOME OF ANY CLIENT BASED ON THE INFORMATION CONTAINED IN THE CLIENT'S FILE. BASED ON TWO PREVIOUS PILOT STUDIES, THE PRESENT STUDY RESULTED IN THE CONSTRUCTION OF A MATHEMATICAL MODEL INCORPORATING METHODS OF REPRESENTING THE INFLUENCES OF THE COMMUNITY, COUNSELOR ACTIVITIES, AND CLIENT CHARACTERISTICS. THE 10 FACTORS EXTRACTED WERE--(1) VOCATIONAL ADEQUACY AT ACCEPTANCE, (2) SEX, (3) CLIENT MATURITY, (4) ACCEPTANCE OF WELFARE, (5) PSYCHIATRIC DISABILITY, (6) VOCATIONAL TRAINING SERVICE, (7) LONG TERM TRAINING, (8) PHYSICAL RESTORATION SERVICES, (9) VOCATIONAL ADEQUACY AT CLOSURE, AND (10) VOCATIONAL ADEQUACY AT FOLLOW-UP. THIS STRUCTURE WAS CONFIRMED BY A PARTIAL CROSS VALIDATION. CONTINUING RESEARCH EVALUATING THE PRACTICAL APPLICATION OF THE FINDINGS, WHICH IS DESIGNED TO PERMIT THE UTILIZATION OF BROADER CATEGORIES OF DATA IS DESCRIBED. (CG)

U.S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE
OFFICE OF EDUCATION

THIS DOCUMENT HAS BEEN REPRODUCED EXACTLY AS RECEIVED FROM THE PERSON OR ORGANIZATION ORIGINATING IT. POINTS OF VIEW OR OPINIONS STATED DO NOT NECESSARILY REPRESENT OFFICIAL OFFICE OF EDUCATION POSITION OR POLICY.

ED019692

MULTIVARIATE ANALYSIS OF THE VOCATIONAL REHABILITATION PROCESS

Final Report
by

Herbert W. Eber, Ph.D.

and

Robert S. Stein, Ph.D.

Alabama Vocational Rehabilitation Agency, Montgomery, Alabama

June, 1967

This investigation was supported, in part, by a research grant, number RD-1518-G, from the Vocational Rehabilitation Administration, Department of Health, Education, and Welfare, Washington, D. C. 20201.

CG 001 884

TABLE OF CONTENTS

I. Special Bibliographic Note..... 1

II. Significant Findings for the Rehabilitation Worker..... 2

III. Introduction 4

IV. Methods and Procedures 6

V. Results 9

VI. Cross Validation and Data Extension..... 14

VII. Continuing Research 15

VIII. Summary 16

IX. References 17

SPECIAL BIBLIOGRAPHIC NOTE

This report is intended for the reader whose primary professional orientation is toward vocational rehabilitation matters. The technical (and mathematical) issues of methodology and of exact numerical results are discussed in detail in two publications, and the technically-minded reader is referred to them. These publications are:

1. **Multivariate analysis of a vocational rehabilation system.** *Multivariate Behavioral Research Monograph* **No. 66-1, available from Multivariate Behavioral Research, Box 30785, Texas Christian University, Fort Worth, Texas 76129.**

2. **Multivariate analysis of a rehabilitation system: cross validation and extension.** *Multivariate Behavioral Research,* **1967, Volume 2, Number 4. Reprints available from the senior author.**

MULTIVARIATE ANALYSIS OF THE VOCATIONAL REHABILITATION PROCESS: Significant Findings for the Rehabilitation Worker

(1) A linear mathematical model of some aspects of vocational rehabilitation was constructed through multiple factor analysis and multiple regression techniques. The model was tested on two pilot samples, a carefully defined main sample, and a small cross-validation sample.

(2) The validity of the model appeared substantial and the degree of prediction of client outcome was sufficient to warrant practical use. Utilizing client information of the type usually available in rehabilitation files, and information regarding the community in which the client lives and the counselor who will work with him, it is possible to make predictions of client outcome with substantial validity so that specific needs, opportunities, and points of concern regarding a client can be identified.

(3) Routine use of the findings requires, in any particular rehabilitation setting, a knowledge of certain community and counselor characteristics and an efficient computing facility. The latter is necessary because the equations are too complex to be solved by non-electronic methods. Support has been requested and obtained for the establishment of such a computing facility in Birmingham, Alabama, and additional comprehensive evaluation of the methods, as well as evaluation of their impact upon rehabilitation practice is under way.

(4) A similar system could be utilized in any state (or other) agency, but parts of the study would first need repetition in the local setting. Consulation regarding such possible use can be made available to interested rehabilitation administrators.

MULTIVARIATE ANALYSIS
OF THE VOCATIONAL REHABILITATION PROCESS
Final Report

RD-1518-G

INTRODUCTION

In the analysis of test findings, psychologists have utilized complex statistical and mathematical procedures which have enabled them to make conceptual sense out of the complicated data that represent the relationships among tests of various kinds. The present study was designed to answer the question whether such mathematical techniques could also be useful in making conceptual sense out of behavioral rehabilitation data. In other words, the files of any vocational rehabilitation client contain a substantial quantity of information describing him; very mundane and ordinary information such as age, sex, education, etc., and rather complex information such as diagnostic judgements, counselors' impressions, response to certain vocational opportunities, and response to the limitations of the disability itself. There seemed to be no inherent reason why powerful mathematical methods could not help in gaining understanding of rehabilitation data in much the same way that such techniques have been useful in the analysis of tests.

It is a truism that rehabilitation, like any other social-psychological-medical-economic process, is a complex matter. Certain relationships between client characteristics and rehabilitation outcome are so obvious that the unaided human eye and judgment can easily understand them, but the same thing is true in the field of mental testing, where certain obvious relationships, primarily those involving intelligence test data, can be understood and utilized without the aid of complex mathematical techniques. However, it seems certain that some rehabilitation relationships are more complex. Perhaps a specific example will help to illustrate the logic of the experimental design.

Among the findings of our study are many which would seem obvious to the experienced rehabilitation specialist. It is certainly not surprising that, on the average, clients who have achieved substantial vocational success prior to their disablement should show more favorable long-range outcome than those who have not. Similarly, it will come as no surprise to experienced rehabilitation workers that clients with a better education achieve a higher level of outcome than those with poor education. Third, it should come as no great surprise that clients whose rehabilitation program includes specific vocational training achieve a more favorable result than those who do not have such opportunities.

Putting together these three findings in a meaningful conceptual application to a particular client, however, is quite another matter from understanding the obvious implications. How much vocational training will be necessary to produce a certain vocational result in a client whose maximum earnings prior to his disability were $26 per week, and whose educational level is that of tenth grade? How would the outcome of such a client, given six months of vocational training in a trade school, compare with that of a person who had earned $75 per week prior to his disability, who had two years of college training, and who was given no additional vocational training during rehabilitation? The point is that the making of a single judgement about a particular client, giving proper weight to various bits of knowledge available about him, is a highly complex task, even though the influence of each fact about the client is roughly known. The purpose of this research project was to formalize our knowledge of obvious (and some not quite so obvious) relationships, so that meaningful prediction of outcome could be attempted when certain characteristics of the client were known.

The goals of the project were two-fold. One major hope was that it would be possible to build a meaningful conceptual structure, within which various factors influencing rehabilitation outcome could be more clearly understood. Broad, pervasive influences of several types must be at work in the progress of a client through a vocational rehabilitation system. We hoped to identify some of these broad influences, not in the sense of permitting complete understanding of everything that happens to a particular client, but in the sense of being able at least to specify some major influences that would be at work. Thus one goal was conceptual understanding of a complex area, understanding which would inevitably simplify the matter (hopefully without too much oversimplification) so that the human mind of the administrator, the counselor, the psychologist, and similar person involved in rehabilitation could gain greater conceptual understanding of the influences in the system.

A second hope for the project was that some of the variation in outcome of any particular client might be predictable on the basis of the type of information normally contained in client files, if we knew how to utilize that information. This result, of course, could not be forced, but rather was subject to empirical verification. A thing is either predictable to some substantial degree or it is not; if it is, then it becomes possible to write the equations for the predictions concerned. If adequate prediction cannot be achieved with a certain set of data, then it is only possible to suggest that the gathering of a broader set of data may, at some time in the future, make possible the desired degree of prediction.

It should be emphasized that there was no hope of perfect prediction; in a world in which a vast number of influences are at work upon the life of each individual, some of these clearly not represented by the data in his file, only massive conceit would lead anyone to anticipate perfect, or even nearly perfect prediction. However, partially accurate prediction is not to be despised. Many studies have demonstrated that the true prediction rate in a variety of expert human judgements is quite poor, and yet, that degree of prediction and understanding which is possible seems valuable.

A baseball player who can predict the behavior of the opposing pitcher sufficiently well to understand and manipulate 30 per cent of the variance achieves a .300 batting average and a s ılary of five figures. It seemed likely that a comparable level of prediction might be achieved through the mathematical model which was to be used. Granted that the ability to predict 30 per cent of the variation in client outcome would not permit a rehabilitation system to be guided exclusively by such predictions, it seemed likely nevertheless that even such imperfect understanding could be of significant help to counselors, to administrators, and to others involved in the work of vocational rehabilitation.

METHODS AND PROCEDURES

It is not our intent in this paper to describe the technical details of research design or mathematical analysis; the interested reader may find these in two publications (Eber, 1966 & 1967), one describing the central research findings and the other giving the results of a cross validation and extension of the data. Rather, we would like to address the present report to the reader who is not primarily interested in the technical methods but who is concerned in the practical rehabilitation applications. Despite this, however, some basic understanding of the procedures is necessary and will here be presented.

The project began with the question "Can we make mathematical sense out of any rehabilitation data?" A set of closure IBM cards were obtained from the Alabama State Office of Rehabilitation in the fall of 1962 and 24 variables of information about each of 426 clients were factor analyzed and rotated to what is technically described as "simple structure". The technique permits the identification of influences at work in producing the relationships among the variables. Ten factors thus represented ten apparent influences, of which eight seemed clearly interpretable; these were: vocational status at acceptance, welfare acceptance, age, time spent in rehabilitation, three types of rehabilitation service, and vocational status at closure.

Relationships among these influences seemed meaningful to rehabilitation specialists who were consulted, although some surprising patterns emerged. For example, it was found that there was no significant relationship between welfare acceptance and vocational status at closure, a finding which would seem to run counter to previous rehabilitation experience, and yet which could have dramatic significance for the planning of rehabilitation programs if confirmed.

Because of the presence of some unexpected findings, and because it was our intent to proceed further with this matter, the cooperation of Georgia Rehabilitation was enlisted, and a second pilot study was conducted with the data representing a randomly drawn 10 per cent sample of Georgia cases for fiscal year 1962. Four hundred and seven cases were chosen by taking every tenth case in an alphabetical stack of cards. Because the cards are used to develop federally required reports, the Georgia cards contained the same data as the Alabama cards, and so a complete cross validation was possible. The same ten factors appeared upon analysis, and essentially the same relationships among these influences were indicated. It was our judgement that the analysis had now proceeded to the point where large-scale attack upon the problem was warranted, At this time, research support was requested from Vocational Rehabilitation Administration and a three-year project was approved.

The major deficiency in the pilot studies had been the preoccupation only with data that were readily available. The closure card prepared for statistical reporting purposes does not contain nearly all the information which seemed most likely to be meaningful in permitting a complex description of broad aspects of client performance. Many things which we would like to have included simply did not appear on these cards. Once research support had been obtained, however, it became possible to attack the problem on a much broader scale, utilizing the data that were considered most desirable rather than those data which happened to be readily available.

Extensive consultation between the investigators and various rehabilitation specialists eventually led to the development of a data set containing 61 varables, of which 51 represented information normally available in case files, whereas ten variables represented follow-up information obtained one year after case closure. The emphasis upon follow-up seemed a most necessary step since, after all, the true goal of rehabilitation is not that the client should perform adequately at closure, but that he should be embarked upon a long period of vocational productivity. These two goals are not necessarily the same thing, and hence we felt strongly that some data should represent the way in which

the client was performing vocationally at some substantial time after closure of his case.

As plans developed, and as specialists of various disciplines gave consideration to the variables to be included in the study, it became evident that some factors or influences outside the client's own characteristics could be of significant impact.

Even the activities of the counselor are not completely represented in the files, since each counselor has general patterns of work performance which do not show in the case records of a particular client, which nevertheless might be expected to exert some influence. Therefore, plans were made to study separately the general patterns of performance of the counselors in the system, and at the same time, a third analysis concentrating upon community characteristics was planned. It was our feeling that, if we could make partial conceptual sense out of the characteristics of the community, out of the general activity patterns of the counselors, and out of the specific characteristics of the client, the total picture would be one including substantial representation of some of the influences that affect client outcome.

Thus the study method involved the construction of three distinct linear models of influences that were thought to be relevant to vocational rehabilitation. In each case, the technique used was linear factor analysis with rotation to oblique simple structure. One analysis dealt with 69 variables of a socio-economic nature describing the counties of Alabama. A second analysis concerned 14 variables describing counselor work patterns. The third, and crucial analysis dealt with 61 variables of client characteristics at intake, during rehabilitation, at closure, and at follow-up. Finally, the results of the three analyses were combined to ascertain the degree to which outcome of VR could be predicted at various stages of a client's program.

The sample for the analysis of community characteristics consisted of all 67 counties of the state of Alabama. Since vocational rehabilitation is organized upon a county basis, organization of the data by these units seemed most likely to yield findings that were applicable to prediction.

The sample of counselors consisted of all the counselors in the state who had accumulated at least one full fiscal year of experience at the time the data were gathered. While this gave only 44 cases, that number represented the total population, and not really a sample in the technical sense.

The client sample consisted of 502 cases, defined as the first 12 1/2 per cent of each counselor's closures for the fiscal year. Each counselor's case closures were listed in chronological order, including

both "rehabitated" and "non-rehabilitated" cases (coded "12" and "13" or "15" respectively). One-eighth of the total number closed by each counselor were then counted in chronological order, yielding a sample containing the correct proportion for each counselor in the state. Ethnic, sex, age, and similar characteristics were checked and found to be consistent with what would be expected from such a stratified sample.

RESULTS

The socio-economic variables yielded a structure of six factors whose reasonable interpretation was conducted with the help of the sociological consultant. These factors were: (1) presence of a large institution of higher learning; (2) age of the county population; (3) level of business activity; (4) level of *family* farm activity; (5) presence of a "plantation" economy; and (6) degree of poverty. It is not our purpose here to discuss in detail the technical characteristics of the socio-economic findings; we were, however, clearly in a position to represent potentially relevant characteristics of each county with a profile of six numbers, and such a set of profiles was developed and utilized in the analysis of prediction.

The data describing the counselor work patterns were analyzed and gave a structure of five factors, clearly representing (1) experience, (2) promotion, (3) case load volume, (4) money spent, and (5) *apparent* efficiency from a cost-accounting standpoint. In regard to the last factor, apparent efficiency, the data suggested that such high productivity per dollar spent did not always yield the most stable and desirable long-range result.

The 61 variables describing client characteristics, and rehabilitation activities relating to these clients, were factor analyzed and ten factors were extracted. Identification of these ten patterns of influence within the data was again relatively easily achieved, and it was no great surprise that the patterns matched quite closely what had been found in the pilot studies. Exact matching was not possible in all cases since the broader set of data now utilized could obviously represent more complex and more complete patterns of relationship.

Some discussion of the specific factors of client performance seems in order here, with apologies to the mathematically sophisticated reader who may find our presentation needlessly detailed.

Factor 1 was a clear pattern of *vocational adequacy at acceptance.* Relations were found to such items as earnings and work status at acceptance, history of previous rehabilitation, health patterns prior to acceptance, and in the long run, subsequent return to rehabilitation for further services. There was some implication that the client who was doing quite well at acceptance tended to receive somewhat less than

maximum services during the program itself, and therefore was somewhat more likely to return for further services, having benefited from those already received.

Factor 2 was a clear representation of *sex*, not only in the simple biological sense, but also including some associated variables. The fact that male clients are heavier and taller than female ones was not surprising; less obvious were some other associated variables including the fact that male clients had less nominal education than females, that males were more likely to receive prosthetic services during rehabilitation, and that males had generally less recent medical contact prior to rehabilitation than did females. The factor thus represents not only sex itself but other variables associated with sex in the client sample.

Factor 3 was clearly one of *client maturity*. Besides age, it included variables such as the client being married, work history prior to disability, wages earned prior to rehabilitation contact, and (negatively) need for rehabilitation center services. The more mature client tended to be accepted more rapidly by the counselor in the sense that time between referral and acceptance was shorter. The factor turned out later to be of substantial influence in the prediction of outcome.

Factor 4 represented the acceptance by the client of *welfare*, or public assistance services, prior to rehabilitation, during rehabilitation, at closure, and at follow-up. No other variables were influenced by the factor, and the interpretation was one of the clearest in the entire analysis. In other words, there is a consistent difference among clients in the degree to which they utilize, are eligible for, and receive welfare benefits, and the relationship of this influence to other patterns was later the subject of some interest.

Factor 5 defined the pattern of *psychiatric disability*, with relationships to variables of psychiatric hospitalization, history of psychiatric contact, and the counselor's utilization of sheltered workshop facilities as part of the rehabilitation program. The factor also related somewhat to a tendency on the part of the counselor to underestimate the difficulty of the vocational problem, an interesting finding in view of other reported experiences as rehabilitation more often attempts to deal with psychiatric disability.

All factors presented up to this point dealt with aspects of the client's characteristics as they were found by the counselor. Adequacy at acceptance, sex and associated variables, maturity, welfare acceptance, and the presence of a psychiatric problem all constituted patterns that might be considered "given" by the client when he presents himself for rehabilitation. The next three factors, on the other hand, represented

patterns of service by the rehabilitation counselor and his agency to the client.

Factor 6 was a pattern of *vocational training service*, showing relationship to variables of rapid service, training of severely disabled persons, direct job placement, and some tendency for the client to return to rehabilitation for further services after closure. The essential vocational orientation of the training was confirmed by the fact that clients with a high score on this pattern spent very little time in "status 6" (ready for employment but not working), implying rapid placement once training had been completed.

Factor 7 was clearly a pattern representing a different type of training activity. This was *long-term training*, perhaps better described as education. There were substantial expenditures of training and maintenance funds, and the training involved was of long duration. Funds were spent for tools (books) and similar purposes, and substantial funds were spent for diagnostic evaluation. In regard to this last point, it seemed that the counselor wanted to know more about the client before obligating heavy expenditures, a meaningful finding. Clients achieving high scores on this factor spent substantial time in Status 6, representing some time lag in placement after the training was completed; however, these same clients showed quite high earnings at follow-up, a particularly significant point indicating that such long-range education is of less direct vocational benefit in the short run, but of significant benefit in the long-range result.

Factor 8 was one of *physical restoration services* with relations to variables involving the expenditure of surgical, medical, and hospital funds. The pattern suggested that such services were performed more often for older than for younger persons, more often for non-white than white clients, most often for clients who would require little or no training, and for those clients whose work history prior to the disability was favorable. Clients with high scores on this factor, representing substantial physical restoration services given, showed favorable outcome at closure but less obviously favorable patterns at follow-up, representing the achievement of a relatively low grade but still quite successful rehabilitation result.

The final two factors appeared to represent the goals of the rehabilitation process, short-range goals in one case and long-range goals in the other. It should be mentioned that our ordering of factors is a purely arbitrary one in this discussion; influence patterns emerge from the computer in random order and there is no implication here that any of these are of particular importance, except as the content makes them obviously of certain importance.

Factor 9 was a pattern of *vocational adequacy at closure*, with relationships to work status at closure, to mobility at acceptance and at closure, to the status of the job achieved, to earnings at closure, and to the simple fact of having been closed "Status 12" (closed rehabilitated). The presence in the factor of every variable associated with successful outcome at the time of case closure, and the absence of any other variables, appeared to indicate very clear definition of this "goal" factor.

Factor 10 represented equally clearly *vocational adequacy at follow-up*. We are reminded that follow-up was, on the average, approximately one year after closure. The variables associated with this factor were employment at follow-up, promotion record, earnings at follow-up, expressed satisfaction with the job, and the counselor's estimate of how successful the result had been. Again, all variables relating to status at follow-up were in the factor, and no others. Again there is clear identification of this second "goal" factor.

Some further discussion of these last two factors seems in order. Researchers in rehabilitation, and in other fields, spend substantial amounts of time and energy discussing the question of what shall constitute "the criterion" in a research study. Is the measure of success of a rehabilitation program to be freedom from physical disability, amount of money earned, stability of vocational performance, promotion record, or what? Depending upon which criterion is accepted in a certain study, the results vary. The importance of the findings here would seem to be that, when a large number of variables describing characteristics of the client are included in the analysis, two clear factors of criteria appear organically in the data. In other words, these patterns were not forced, but rather appeared or emerged from the data because they were inherently there. The finding that there are two factors of success, one at closure and one at follow-up, which though related to each other are not the same thing, seems completely consistent with the experience of rehabilitation specialists. The fact that these patterns can be defined precisely through the techniques inherent in this study seems an obvious benefit, not only for the further work to be described here, but for other rehabilitation research.

It seems worth emphasizing also that, of the eight factors clearly identified in the pilot studies, six were confirmed within this analysis. Moreover, three of the new factors appearing here could not have appeared in the pilot studies because the basic data required for their definition were not included at that time. The fact that the findings have been essentially the same on three different occasions suggests that the results warrant substantial confidence.

A factor analysis of the type described also permits the analysis of correlations among the factors, that is, the degree to which there exist relationships among the patterns of influence. Detailed discussion of these is beyond the scope of this presentation, but there is a general pattern of results running through the entire set of data which warrants some discussion.

This general trend is that, in the short run, up to the point where the case is closed, rehabilitation programs can and do neutralize the "given" characteristics of the client to a remarkably successful degree. For example, the relationship between adequacy at acceptance and adequacy at closure is trivial. The relationship between welfare acceptance and adequacy at closure is trivial. The relationship between client maturity and adequacy at closure is trivial. However, in the long run, as represented by the factor of adequacy at follow-up, the basic characteristics of the client tend to reassert themselves. Thus there is four times as much relationship between adequacy at acceptance and long-range adequacy as between adequacy at acceptance and adequacy at closure. Maturity similarly shows four times as much relationship with the long-run result as with that in the short run. Psychiatric disability does not negatively influence closure results, but shows powerful negative influence upon long-range outcome. The point is that the influence of rehabilitation upon the behavior and vocational success of the client is quite effective, but some of that success is temporary, and the client tends to reassert that basic nature which was represented prior to the time that he came into the rehabilitation program, as soon as the counselor withdraws his support and leaves the client to his own devices.

This in turn has powerful implications for rehabilitation practice. It is possible to identify those clients who are most likely to revert to an unsatisfactory vocational adjustment pattern once the case is closed and rehabilitation support is withdrawn. Selective long-term follow-up of these clients, continuing rehabilitation support well past the time when it normally would be terminated, may help such a client. Moreover, if a rehabilitation agency should decide to devote more attention to these long-range patterns, either through the provision of substantially increased services to closed cases or through a much slower closure procedure, the possibility of identifying those clients who stand most in need of such continuing support would seem of substantial practical significance.

Some other patterns of relationships among the various factors seem worthy of mention. Of particular significance in this regard are the results of the three factors representing what the rehabilitation system offers to the client. Vocational training, for example, shows strong and

direct favorable influence upon short-range and long-range outcome. Long-term educational benefits similarly show such effects. Physical restoration services tend to be more useful in terms of the client's long-range adjustment than in terms of results observable at closure. The tendency of some rehabilitation specialists to rate such services as relatively unimportant seems contraindicated by these data.

CROSS VALIDATION AND DATA EXTENSION

The sample of 502 clients upon whom the main analysis was performed was one representing VR as practiced in Alabama in fiscal year 1964. A smaller, quite different sample was also available for analysis, one upon whom psychometric data were also available. We decided to combine a further cross validation with an analysis of an expanded data set, utilizing this sample.

The writer's files contained data upon 180 cases who had been referred for psychological evaluation in 1961, prior to the initiation of VR services, and who had been able to read sufficiently well (grade level 5.5 or better) to produce standard personality data. For all these clients, the files contained a Wechsler Verbal and/or a Culture Fair IQ and the sixteen scores from the 16 Personality Factor Test (Cattell and Eber, 1964). The same 61 variables of rehabilitation and follow-up data that had been used in the main analysis were developed upon this new sample; difficulties in locating clients for follow-up after an interval of five years reduced the sample to 112 cases.

Factor scores (one score per client for each of the ten factors) were developed and intercorrelated to yield a matrix of empirical factor correlations on the new sample; second-order factor analysis was then applied concurrently to two matrices, one representing the theoretical relationships in the main sample of 502 cases, the other the actual relationships in the new sample of 112. The independent factorings yielded very similiar results, with all differences clearly attributable to different characteristics of the clients in the two samples. For example, certain training opportunities are more readily available for the urban client (in the new sample) than for the average client in the state. The comparison of the results reflected such differences, but clearly confirmed the similarity of the data structure in the two samples.

Thus, in four independent samples of clients, the same structure was found. The results seemed to confirm the belief that mathematical models of a linear type could, and did, permit meaningful conceptualization of rehabilitation data.

Turning to the extension of the data set through psychological tests, the new sample data suggested that substantial relationships existed

between intelligence and personality characteristics of the client on the one hand and VR outcome on the other. These data require extensive cross validation before extended use, and such procedures are incorporated in ongoing research; however, it is not too early to report some tentative findings.

The intelligence data supported the expected relationships that brighter clients would show more favorable VR outcome, but this trend was stronger in short-range than long-range terms. The B factor of the 16 PF, a brief intelligence scale included among the personality data, showed the same relationship.

In the personality area itself, the findings emphasized the favorable influence, upon rehabilitation outcome, of factors C+ and O+ suggesting that ego strength and the williness to feel guilt (and therefore responsibility) are valuable characteristics of the successful VR client. Some extraversion traits seemed useful in the long run but not in the short run, possibly reflecting some association between extraversion and freedom from psychiatric disorder. Tension (factor Q4) appeared helpful in long-range outcome if adequately controlled by ego mechanisms. These results are tentative, but seem sufficiently interesting to warrant the further investigation now under way.

CONTINUING RESEARCH

The findings reported here, and in the two technical articles, contain two major implications for further study. One of these is that an expanded set of data presumably could yield even more meaningful and precise prediction and control of the rehabilitation process. The second is that the findings presently in hand can fruitfully be applied to rehabilitation systems.

Upon termination of the present study, the staff requested and obtained both state and VRA support for more extensive work, and this work is presently under way. Since the mathematical model can be utilized for predictions of client outcome based upon real or upon simulated data, it was felt that making such predictions directly available to rehabilitation counselors while they are working with a client might be of significant help in the achievement of rehabilitation goals. For example, we could identify those clients who are likely to benefit from longer range rehabilitation service, and the provision of such services by some counselors to some clients would permit evaluation of our hypothesis that such services would be helpful.

Since the equations representing the application of the mathematical model to a particular client are quite complex, it was not possible that counselors utilize these findings without substantial computational aid.

Therefore, a computing center has been placed in the building with a group of twenty counselors, a computer facility designed to permit immediate analysis of client records at the counselors' request. This computation center is currently functioning and, with a view to serving also the project of analyzing a larger data set, the computer records are being augmented to retain in storage substantial data in addition to those directly useful for prediction purposes in terms of our present knowledge. It may also be worthy of mention that a control group constituted by one-third of the cases submitted by counselors is being maintained, so that it will be possible to compare directly the eventual outcomes of cases where the counselor obtains and utilizes predictive information with those where he does not.

A final comment regarding the expanded data set may be in order. The predictive system currently uses 61 items of client information as developed in this project. Cross validation of promising intelligence and personality predictors is under way. In addition to this, the expanded data set will include functional codes of disability similar to those developed in the VRA sponsored project "Rehabilitation Codes". Community and counselor characteristics developed in this study are being utilized now for prediction, and their cross validation is also included in the research plan.

SUMMARY

(1) The logic and the method for the development of a mathematical model that may represent some aspects of the vocational rehabilitation process have been presented.

(2) The results of two pilot studies were reported.

(3) The present study resulted in the construction of a useful mathematical model incorporating methods of representing the influences of community, of counselor activities, and of client characteristics. The model permitted substantial prediction of rehabilitation outcomes.

(4) A partial cross validation, confirming the structure found in the main study, has been reported.

(5) Initial results utilizing an expanded data set, one that includes intelligence and personality measurements, seemed to warrant further investigation.

(6) Continuing research evaluating the practical application of the findings, and designed to permit the utilization of broader categories of data, has been described.

REFERENCES

Cattell, R. B., & Eber, H. W. *Handbook for the 16 personality factor questionnaire.* Champaign, Illinois: IPAT, 1957 (with 1964 supplementation).

Eber, H. W. Multivariate analysis of a vocational rehabilitation system. *Multivar. Behav. Res. Monograph,* 1966, No. 1.

Eber, H. W. Multivariate analysis of a rehabilitation system: cross validation and extension. *Multivar. Behav. Res.,* 1967, 2 (4).